BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

TECHNICAL SPECIFICATION FOR THE L.T AERIAL BUNCHED CABLES.

1.0 SCOPE:

1.1 This specification covers the design, manufacture, testing, inspection, packing, transportation and delivery of Cross linked polyethylene (XLPE) insulated Aluminium Cables twisted over a central aluminium alloy insulated messenger wire (along with associated accessories) for use on LT overhead distribution feeders, supply of required accessories and installations. The cable should be suitable for use on three-phase AC (Earthed) system for rated voltage up to and including 1100 Volts and UV protected.

1.2 The cables should be suitable for use where the combination of ambient temperature and temperature rise due to load, including temperature exposure to direct sunlight results in conductor temperature not exceeding the following:

Table: 1

Type of Insulation	Normal continuous Operation	Short circuit Operation
Cross linked polyethylene	90° C	250° C

2.0 APPLICABLE STANDRADS:

The following standards with latest updates shall be applicable unless otherwise specified:

a. IS:14255-1995 Aerial Bunched cable for working voltage up to and including 1100 Volts.
b. IS:10810 (Series) – Methods of testing cables.
c. IS : 8130 – 1984 for Aluminium conductors for insulated electric cables.
d. IS : 398 (Part-IV) 1994 : For all Aluminium Alloy Conductors (AAC) for overhead transmission purposes.-PART 4 Aluminium alloy stranded Conductors (aluminium– magnesium-silicon type).
e. IS:1885 (Part32) – Electro technical voculabory:Part32 Electric Cables.
f. IS: 6474 for insulation.

2.1 LT Aerial Bunched Cables:

Electrical Data:

a. The rated voltage of the cables shall be 1.1kV.

b. Highest system voltage: 1.2 kV.
c. Test Voltage: i) 2.5 kV / 50 Hz/ 5 min for routine tests.
ii) 4 kV / 50 Hz/ 4 Hrs. for type tests.
d. Max. short circuit current 1.0 kA for 1 Sec..
e. Current carrying capacity at different ambient air temperatures of different sizes of phase conductors are tabulated at Table - 2.

THE CURRENT RATING AND SHORT CIRCUIT CAPACITY SHALL BE AS GIVEN BELOW:

Table - 2

Nominal sectional area	Current rating at 40°C (approx) Amps	Short Circuit capacity KA/1Sec.
(mm2)	**XLPE**	
16	74	1.50
25	100	2.35
35	125	3.29
50	150	4.70
70	186	6.58
95	230	8.93

3.0 GENERAL :

The insulated phase conductors shall be twisted around the insulated aluminium alloy messenger wire, which shall take all the mechanical stress. The messenger wire shall also serve as the earth-cum-neutral wire and shall be insulated.

3.1. CONDUCTORS :

3.1.1 The phase conductor shall be of Aluminium round, stranded and compacted aluminium wires confirming to H2 or H4 grade aluminium complying with requirements of IS:8130, the nominal cross sections and corresponding conductor diameter and number of wires etc., shall be as per clause 3.1.8 of this specification.

3.1.2 The phase and neutral conductors shall be insulated with black weather resistant Cross linked polyethylene insulation by extrusion process and suitable for 1100V insulation. The insulated conductors shall generally conform to the relevant IS standards as noted in clause 2.0 above. The thickness of insulation shall not exceed the limits specified in clause No.7.2, Table 4 and tolerance shall be as per clause No. 7.3 of IS:14255.

3.1.3 The power / outer –insulated neutral / street lighting conductors shall confirm to flexibility class 2 of IS 8130. The messenger cum neutral

conductor or otherwise shall either be stranded circular or compacted circular type and shall have minimum of 7 strands. The surface of the conductor shall be smooth.

3.1.4 The messenger cum neutral conductor shall be heat treated aluminium magnesium – silicon alloy wires containing approx 0.5% magnesium and 0.5% silicon confirming to IS 398 Part-4 with latest revision thereof.

3.1.5 A protective barrier shall be applied between conductor and insulation. The barrier shall be compatible with insulating material and suitable for operating temperature of the cable.

3.1.6 The size of the street lighting conductor shall be 16sqmm.

3.1.7 <u>DIMENSIONAL AND ELECTRICAL DATA</u>.

3.1.8 The dimensional and electrical data for the cable and street lighting conductor shall be as given in Table 3, below. The resistance values are the maximum permissible.

Table 3:

Nominal sectional area (mm2)	**No of strands**	**Dia. Of compacted conductor (mm)**	**Approx. mass (Kg/ km)**	**Max. DC resistance at 20C/KM**	**Insulation Thickness (mm)**
(1)	(2)	(3)	(4)	(5)	**(6)**
16	6	4.4	42	1.91	1.2
25	6	5.5	65	1.20	1.2
35	6	6.8	95	0.868	1.2
50	6	7.9	127	0.641	1.5
70	12	9.6	184	0.443	1.5
95	15	11.3	254	0.320	1.5
120	15	12.9	315	0.253	1.5

Note: a).The Resistance value given in col. 5 are max. permissible.
b).Tolerance of + 5% is allowable on diameter shown in col.3

3.1.9 <u>Phase Identification</u> :

Durable and clearly visible longitudinal ridges shall be provided as follows on each insulated conductors as indicated below for identification of phases.

For phase conductors (3 Core Cable) = R, Y, B
For Street Light Conductor = SL
For Neutral/Messenger Conductor = N

Approx. ridge dimensions are:

- Width = 1.00 mm
- Height = 0.4 mm
- Distance between consecutive ridges = 2.7 mm.

4.0 INSULATED MESSENGER (NEUTRAL CONDUCTOR) :

4.1.1 The messenger shall be an All Aluminium Alloy conductor composed of 7 Wires each of nominal dia 3.55 mm Dia drawn from rod, which is manufactured in a continuous casting and rolling procedure. The properties for the individual wires before stranding shall be.

- Tensile strength not less than 294 N/mm^2
- Elongation on 200 mm not less than 4%.
- Resistivity at 20 Deg. C not exceeding 0.0328 ohm Sq.mm/m
- Density at 20 Deg. C 2.7 Kg/cubic – m.

4.1.2 No joints are allowed in the messenger except those made on the base rod or wire before final drawing. The messenger shall be round, stranded and compacted to have smooth round surface.

4.1.3 The messenger takes all the mechanical stress and also serves as neutral conductor. The size and requirement of messenger conductor for minimum DC resistance and minimum breaking load shall be as per clause No.6.5 and Table 4 of IS: 14255.

Table-4

Sl. No.	Nominal Cross Sectional Area of Phase Conductor mm²	Messenger Conductor		
		Nominal Cross Sectional Area mm²	Maximum DC Resistance at 20º C ohm/km	Minimum Breaking Load kN
1.	16	25	1.38	7.0
2.	25	25	1.38	7.0
3.	35	25	1.38	7.0
4.	50	35	0.986	9.8
5.	70	50	0.689	14.0
6.	95	70	0.492	19.7

Note: While the limiting values in Col. 4 & 5 are to be guaranteed, a tolerance of +5% will be permissible on values in Col.2.

5.0 DESIGN:

5.1.1 The cable consists of three phase aluminium conductors and one street light aluminium conductor with black weather resistant special high density Cross linked polyethylene insulation, shall be twisted around a insulated all aluminium alloy messenger which is also the neutral conductor without fillers with lay not exceeding 35 times the diameter of the insulated phase conductor.

5.1.2 The thickness at any place may be less than the specified average value, provided that the difference does not exceed 0.1 mm + 0.1(ti) of the specified average value in clause No.7.2, Table 5 and tolerance shall be as per clause No. 7.3 of IS:14255.

5.1.3. The insulation shall be applied that fits closely on the conductor (or barrier, if any) and it shall be possible to remove it without damaging the conductor. Further, for the thickness of insulation, six measurements are made radially on a piece of insulation, as far as possible equally spaced around the circumference but not on the ridges.

5.1.4. The insulation shall be black weather resistant suitable for 1100V and confirming to IS:6474.

5.1.5. The properties of XLPE insulation shall confirm to clause No. 5.1, Table 1 and 2 of IS: 14255.

5.1.6. The insulation shall be XLPE of nominal thickness and its properties shall confirm to IS: 7098 & IS: 6474. The black carbon content in XLPE shall be 2% only.

6.0. Designation and parameters of the Finished Cables:

The designation and parameters of the finished cables shall be as given in the Table 5 below. The first part of the designation refers to the Number & size (cross sectional area in sq.mm) of the Phase Conductor, the second part refers to the (cross sectional area in sq.mm) of the Messenger.

Table: 5: Sizes

Description of Sizes	Complete Cable	Bunched
	Approx. Overall dia. (mm)	Approx. Cable mass (Kg/Km)
3x16+1x16+1x25	19	310
3x25+1x16+1x25	22	390
3x35+1x16+1x25	24	490
3x50+1x16+1x35	32	640

3x70+1x16+1x50	34	890
3x95+1x16+1x70	39	1180
3x95+1x25+1x70	41	1260
3x95+1x35+1x70	43	1360
3x120+1x16+1x95	42	1430

7.0 TYPE TESTS ON LT AB CABLE:

Unless otherwise stated in this specification, the type tests and routine/acceptance tests shall be carried out in accordance with the appropriate clauses of IS:14255 and IS:10810.

8.0 TYPE TESTS AS PER CL.10.1 AND 11.4 OF IS:14255/1995 :

a) Tests on phase/street light conductor
   i) Tensile Test
   ii) Wrapping Test
   iii) Resistance Test
b) Tests on messenger conductor
   i) Breaking Load
   ii) Elongation Test
   iii) Resistance Test
c) Physical test for XLPE Insulation:
   i) Tensile strength and elongation at break
   ii) Ageing in Air oven
   iii) Hot set test
   iv) Shrinkage test
   v) Water absorption (Gravimetric)
   vi) Carbon black:
      - content
      - dispersion

d) Test for thickness of insulation
e) Insulation resistance (volume resistivity)
f) High voltage test
g) Bending test on complete cable
h) Ultra violet test on cable to withstand ultra violet radiation.

8.1 ACCEPTABLE as per Cl.10.2 of IS: 14255/1995 :

a. Tensile tests for phase/street light conductor.
b. Wrapping Test for phase/street light conductor.
c. Breaking load test for messenger conductor.
d. Elongation test for messenger conductor.
e. Conductor resistance test.

f. Test for thickness of insulation.
g. Tensile strength and elongation at break
h. Hot set Test for XLPE Insulation.
i. Insulation resistance test.
j. High voltage test
k. High Voltage Test on DRUM, immersed in water & apply test voltage 3.5kV AC for 5 min.
l. Weather ability test for withstanding weather conditions.
m. Adherence test on insulated messenger wire

8.2 ROUTINE TESTS as per Cl.10.3 of IS: 14255/1995:

a. Conductor Resistance Test.
b. High Voltage Test

8.3 OPTIONAL TEST: This test to be insisted as part of Acceptance tests during inspection.

Bending Test on the Complete Cable :

The test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180 Deg. The cycle of these operations shall then be repeated more. The diameter of the mandrel shall be 10 (D + d).

Where D= actual diameter of the cable (i.e., minimum circumscribing circle diameter in mm) d= actual diameter of the conductor in mm. No cracks visible to the naked eye are allowed.

Type Test Report:

The bidder shall submit type test reports for the particular sizes asked in the tender for the type tests carried out from NABL accredited Laboratory and the reports should not be older than 5 years as on the date of opening of tender. The bid not carrying valid type test reports will not be considered for evaluation.

8.4 SAMPLING OF CABLES:

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot. Samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirement of the specification. The number of drums(n) to be selected from the lot of drums(N) of consignment of cables shall be in accordance with column 2 and 1 of following table:

Table 6: Number of Drums to be selected Sampling and permissible

Number of Defectives.

Number of Drums in the Lot (1) N	Number of Drums to be Taken as Sample (2) n	Permissible Number of Defectives (3) a
Upto 50	2	0
51 to 100	5	0
101 to 300	13	0
301 to 500	20	1
501 and above	32	2

The sample shall be taken at random. In order to ensure randomness of selection, random number table shall be used as per IS 4905.

Number of tests and criteria for conformity: Suitable length of test sample shall be taken from each of the drums selected. The test sample shall be subjected each of the acceptance test. A test sample is defective if it fails in any of the acceptance test. If the number of defectives is less than or equal to the corresponding permissible defective(a) given in the table 9 the lot shall be declared as conforming to the requirements of acceptance test, or otherwise not.

9.0. **PACKING AND MARKING :**

The Cable shall be wound on non-returnable wooden drums conforming to IS: 10418 /1982 with latest amendment thereof. The ends of the cable shall be sealed by means of non-hygroscopic sealing materials. The drum shall be marked with the following.

a. Manufacturer's Name or Trade Mark.
b. Type of cable and voltage grade.
c. Drum number or identification number.
d. Number of cores and size of cable.
e. Number and length of pieces of cable in each drum.
f. Gross / Net mass of the cable.
g. Direction of rotation of drum. (By means of an arrow).

9.1 The drums shall be of such construction as to assure delivery of conductor in the field free from displacement and damaged and should be able to withstand all stresses due to handling and the stringing operation so that cable surface is not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lagged on the drums. The cable drum shall be suitable for wheel mounting.

9.2 The min. drum length of cable shall be 500 mtrs, the tolerance ± 5%.

9.3 MARKING OF CABLE:

All the cables shall have the following marking embossed on the insulated phase conductors for identification: letters **BESCOM; Ref P.O & Date** in addition to manufacturer's name or trade mark year of manufacture at regular intervals of not more than one meter. The cables with cross linked polyethylene insulation shall be identified throughout the length of the cable by the legend 'XLPE 90'.

10.0 QUALITY ASSURANCE PLAN

10.1 The successful bidder shall submit following information to the owner.

10.2 Test certificates of the raw materials and bought out accessories.

10.3 Statement giving list of important raw materials, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

10.4 List of manufacturing facilities available

10.5 Level of automation achieved and lists of areas where manual processing exists.

10.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

10.7 List of testing equipments available with the bidder for final testing of equipment along with valid calibration reports.

10.8 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

10.9 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

11.0 GUARANTEE:

The supplier of AB Cable shall guarantee overall satisfactory performance for minimum period of 5 years.

11.1 At least three copies of latest type test reports shall be furnished. One copy shall be returned duly certified by the owner, only after which the commercial production of the concerned material shall start.

11.2 Copies of acceptance test reports shall be furnished in at least five sets (each set for GM, TA&QC/Procurement/P&M). One copy shall be returned duly certified by the owner, only after which the materials shall be dispatched.

11.3 Record of routine/internal test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

11.4 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

12.0 INSPECTION:

12.1 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where AB Cables and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

12.2 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain AB Cables manufactured in 3-4 consecutive weeks.

12.3 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

12.4 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the later case also the material shall be dispatched only after satisfactory testing specified here in has been completed.

12.5 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection, if such materials are later found to be defective.

12.6 The prospective bidders should furnish the GTP of AB Cables as per Annexure-1.